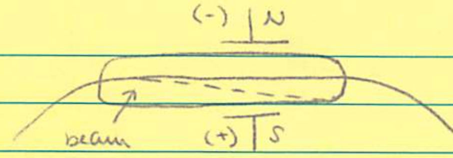
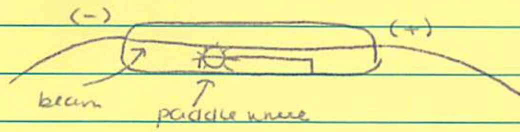
10-12-05

• Thompson → CRT (1897)



1) Beam deflected away from (-) electrode. (implies) ⟹ Beam is negative.

2) Paddle wheel experiments.



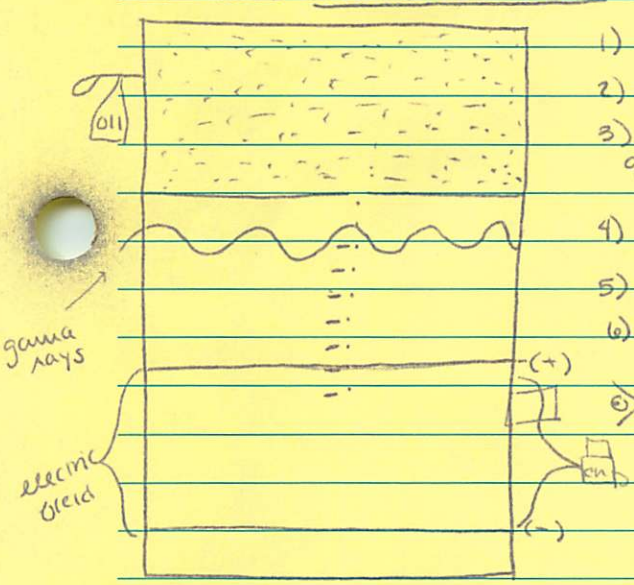
→ wheel always moved to the (+) electrode
⟹ small particles hitting wheel to move.

⟹ Beam made of (-) particles called electrons (e^-)

3) Found charge : mass ratio. → $1.76 \times 10^{8} \frac{C}{g}$ [coulomb → unit of charge]

⟹ Because its such a big #, e^-s must be really really small.
– if one figures out charge → find mass
– if one figures out mass → find charge.

• (~1900) Millikan's Oil Drop



1) sprayed oil into top chamber
2) gravity pulls oil down into bottom chamber.
3) oil is subjected to gama (γ) rays which strip e^-s off air molecules & deposit them on oil
→ oil is now negative.
4) oil enters an electric field. oil is repelled by neg. electrode.
5) → Millikan can find charge to make the oil float.
6) B/c oil drops are different sizes, each requires a different charge to float.
⟹ * all charges to make oil float are multiples of the same # ($\boxed{1.6 \times 10^{-19}\ C}$)
↳ charge of an electron!
[can't have 1/2 of an electron → as * same #].

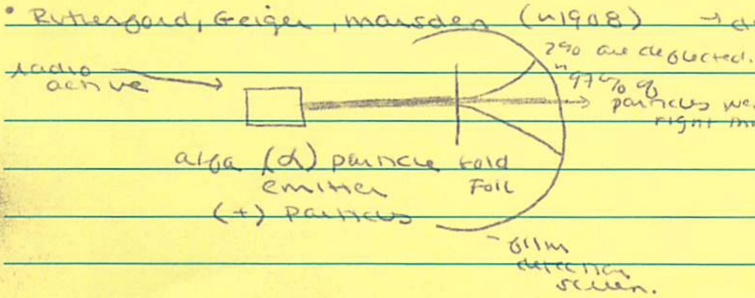
• $1.76 \times 10^{8} \frac{C}{g}$

• $1.6 \times 10^{-19}\ C$ → mass of an e^-? → $\frac{C}{\frac{C}{g}}$

$$\frac{1.6 \times 10^{-19}\ C}{1.76 \times 10^{8} \frac{C}{g}} = \boxed{9.1 \times 10^{-28}\ g} = \text{mass of an } e^-.$$

• Todays standards → 9.109×10^{-28} g

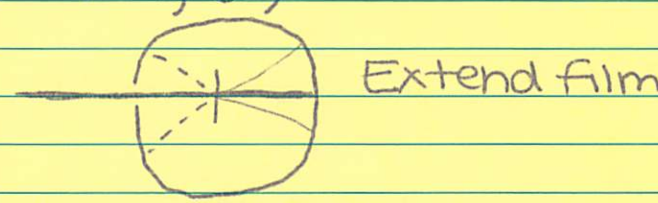
• Rutherford, Geiger, Marsden (~1908) → discovered the nucleus.



10/13 **Rutherford and Alpha Particle Experiment**

1. Deflections of alpha particles occur because they are passing near something (+)

Other 1%?
- Deflected back



2. Some particles bounce back off foil
   ↳ positive "thing" in foil is very dense

Dense, positive particle in foil called the nucleus

3. Since most of the particles pass through, the atom is mostly empty space

Rutherford's Model of the atom (theorized)
- e^- orbit the nucleus like planets orbit the sun

Incorrect

10/13 Anatomy of the Atom

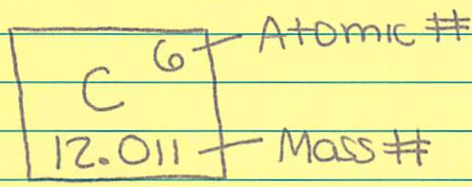
3 parts	mass	Charge
Proton (p)	1.673×10^{-24} g	$+1.6 \times 10^{-19}$ C
Neutron (n)	1.675×10^{-24} g	0
Electron (e^-)	9.109×10^{-28}	-1.6×10^{-19} C

(Proton, Neutron) → 1836 times heavier than electrons

All atom's mass is from proton + neutron

Proton	+1	
Neutron	0	Relative Charge
Electron	-1	

Atomic # → number of protons
↳ dictates element



Mass # → number of protons + number of neutrons

# of n for C = 12 - 6 = 6 * Must be in whole numbers

Cannot have fractions of neutrons

Mass # → weighted average

of e^- for atom → same # of p
for ions → (charged atom)
cation → e^- are lost
(Positive) # depends on magnitude of charge Remove e^-
an ion → negative ion
↳ e^- gained
depends on magnitude of charge add e^-

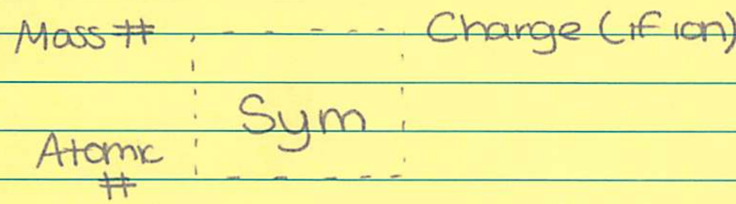
Oxidation - loss of e^-

$2e^- + O \longrightarrow O^{2-}$ Reduction - gain of e^-

Notations

- **Hyphen notation** - (dealing w/ isotopes)
  - element name - mass #
  - Carbon - 14
  - Carbon - 12

- **Symbol notation**



$^{14}_{6}C$

10-14-05

Isotopes - atoms of the same element w/ different masses (AKA nuclides)
→ vary in # of neutrons.

• common isotopes.
→ C-12 → $^{12}_{6}C$ → P 6 : N 6 : e⁻ 6 ...
→ C-13 → $^{13}_{6}C$ → 6 : 7 : 6
→ % Abundance C-12 → 98.85%
C-13 → 1.15%.
[sig. digs live at C-14]
[on periodic table → atomic masses → take in weighted avg.'s]

• Isotopes of H [3 of them]

	p	n	e⁻	
• Hydrogen-1 (AKA Protium)	1	0	1	→ H^+ [also called a proton]
• Hydrogen-2 (AKA Deuterium)	1	1	1	- used to moderate chemical reactions [called heavier water]
• Hydrogen-3 (AKA Tritium)	1	2	1	→ is radioactive [used in nuclear fusion]

10-17-05

• relative atomic mass - talk about masses of single atoms.
→ units - atomic mass units (AKA amu or u)

*based to make lives simpler.

• mass of 1 oxygen atom → 2.65 × 10^{-23} g.
→ relative atomic mass → 16 amu. - designed to accomodate protons & neutrons PLUS make it easier to say.

- relative mass → based on ^{12}C.
- measured mass of ^{12}C atom. (≈1.99 × 10^{-23} g)
→ designated to be exactly 12.00 amu - picked carbon b/c it's soo abundant.
[easier to handle & now can tell how many (+)'s & n.'s there are.

• 1 amu = 1.66 × 10^{-24} g.
- protons & neutrons → fundamental units - shouldn't fluctuate. → just adding/subtracting constants.

[for oxygen]
• 16 amu · $\frac{1.66 \times 10^{-24} g}{1 amu}$ = 2.66 × 10^{-23} g

• mass of a proton → 1.673 × 10^{-24} g → lower b/c → in nucleus → (+) near (+) → like charges repel - so much E holding it together → mass difference → mass converted to E to hold protons together. → E released when atom's split.

• average atomic mass [are #'s on periodic table → averages] - weighted average of atomic mass that factors in % abundance of each isotope.
[figure this out by firing the atom through a magnetic field & see how much its deflected]

ex... ^{12}C ^{13}C → avg → NOT 12.5
98.90% 1.10%
(in world) → avg. (real) mass → 12.011 amu.

• avg. mass = (%₁)(atomic mass₁) + (%₂)(atomic mass₂) + ...

ex. w/ C → (0.9890)(12.00 amu) + (.0110)(13.003355 amu) = 12.011 amu (sig figs)

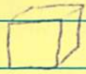
• ex. 2. → Cu. < Cu-63 → 69.17% → mass: 62.93 amu; Cu-65 → 30.83% → mass: 64.93 amu → find average atomic mass
(.6917)(62.93 amu) + (.3083)(64.93 amu) → 63.5466 amu. (55) sig figs.

• ex 3 → H-1 →
H-2 →

10-19-05 ✯ → Avogadro's #

• The Mole → the number of atoms are in 12.00 g. of ^{12}C → 6.022×10^{23} atoms in a mole.

- taking atomic #, setting it in g.'s & figuring out atoms.

 based on volume of cube & then find atoms.

→ b/c p, n, e⁻ → are constant.

• 6.022×10^{23} things in a mole.

10-21-05

[review from wed.] • the mole → # of atoms in 12.0 g. of ^{12}C

↳ 6.022×10^{23} atoms [avogadro's #]

→ will use as a conversion factor.

ex. 5.14 mol. B = ___?___ atoms.

$5.14 \text{ mole } B \cdot \frac{6.022 \times 10^{23} \text{ atoms } B}{1 \text{ mole } B} = 3.09 \times 10^{24}$ atoms B

✯ need to show element in work

ex 2 mole ⟷ atoms × $\frac{\text{atoms}}{\text{mole}}$

$1.09 \times 10^{21} \text{ atoms } Ei \cdot \frac{1 \text{ mole } Ei}{6.022 \times 10^{23} \text{ atoms } Ei} = 1.81 \times 10^{-3}$ moles Ei

"Whenever I convert from atoms to moles, I will only use avogadro's #."

- J.S.S. 10-21-05

ex 3. atoms → moles • $\frac{\text{moles}}{\text{atoms}}$.

• molar mass → the atomic mass in grams

→ units: $\frac{g}{mol}$

ex. 4 2.05 g. Cr = ___?___ mol. Cr

$2.05 \text{ g Cr} \cdot \frac{1 \text{ mol Cr}}{52.0 \text{ g Cr}} = 0.0394$ mol Cr.

atomic mass

ex 5 3.14 mol. Ar. = ___?___ g. Ar.

$3.14 \text{ mol Ar} \cdot \frac{39.9 \text{ g Ar}}{1 \text{ mol Ar}} = 125$ g Ar.

• mole "flow chart"

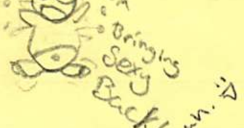
[ ] • $\frac{1 \text{ mole}}{6.022 \times 10^{23} \text{ atoms}}$ [ ] • $\frac{1 \text{ mole}}{\text{atomic mass of element g}}$

atoms ⟷ mole ⟷ grams

[ ] • $\frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mole}}$ [ ] • $\frac{\text{atomic mass of element g.}}{1 \text{ mole}}$

"I will NEVER go from atoms directly to grams. I will always go through the mole & viceversa."

- Jessica Sadick 10-21-05


I'm Bringing Sexy Back! yeah. :D

10-07-05 (~800 BC) The Atom Chpt 3 Test/Review starts here.

• Democritous – an ancient Greek philosopher; coined the term "atom" → all matter is made of indivisible particles called atoms. → just thinking – no tech. aspect.

• Aristotle – 4 element theory (Earth, air, fire, & water) → begin to experiment + proof. lead/

• Alchemists (1600s) – thought of as being early chemists. – ex. regular metals → gold.

• Antoine Lavosier (1680-1690s) – Known as the Father of Chemistry; proved O_2 was required for combustion (there fore fire wasn't an element). → just a chemical reaction – gives off E.

★ balance → allows for so much info → w/ Law of Conservation & LDC (L. of Def. conserv.), etc.

• Dalton (1803) – published the atomic theory

1) all matter is made of atoms. (clues to Democritous)

2) atoms of the same element = same size, mass, props. (LDC)

∃ atoms of different elements = diff. size, mass, props.

3) atoms cannot be created, subdivided, or destroyed (LCM)

4) atoms combined in small whole # ratios → form compounds.

the Law of multiple proportions (LMP)

ex. CO → 1:1

CO_2 → 1:2

$CO_{\frac{1}{2}}$ → X can't happen!!

5) In reactions (Rxn), atoms are separated, rearranged, and combined.

Exceptions

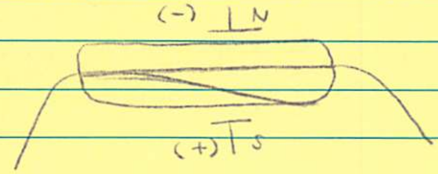
• In #2 → can subdivid atoms into protons (P), neutrons (N), e^- (electrons) — can subdivid protons, etc. etc.

• In #3 → can destroy atoms → nuclear rxns ($E=mc^2$)

• In #3 → can create elements – they're manmade (93+P). [very unstable].

• in #2 → same element w/ a different mass = isotopes (# of n's varies) ex C_{14}

• Thompson (1897) – discovered the e^- (w/ cathode ray tubes) = (CRT)



Deductions

1) beam's negative [charge] b/c its repelled by a (–) charge.

Ch 3 HMWK

Read Ch 3

pg 69 Q 2,3

" 85 Q 2,3,5,6

" 87 Rev Conc 2,4,5

pg 87 Prob 17,19

pg 88 Q 2,3